



Waste Reduction Partners

ENERGY ASSESSMENT

United Church of Chapel Hill

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SPONSORED BY:

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Energy Assessment - Executive Summary

Introduction

United Church of Chapel Hill located in Chapel Hill houses the activities which constitutes being a church. The United Church of Chapel Hill requested that Waste Reduction Partners (WRP) perform an energy assessment of their facility to potentially reduce their energy costs. The church in general has been proactive in energy conservation activities to control and lower energy costs. Also, they have started a "United Earth Ministries" program within the church and have set a goal of reducing their carbon footprint by 40% by 2020. The following report covers the results of the audit and recommendations to reduce energy costs.

Facility Description

The 37,500 square building was built in two sections, the first section in 2000 and the addition in 2007. It is a two-level structure; the upper contains the sanctuary, offices, fellowship hall, meeting rooms and the main kitchen. The lower level is mainly school classrooms. The church is utilized 7 days per week, 12 hours per day and serves up to 450 persons in a normal week.

Summary of Energy Benchmarks

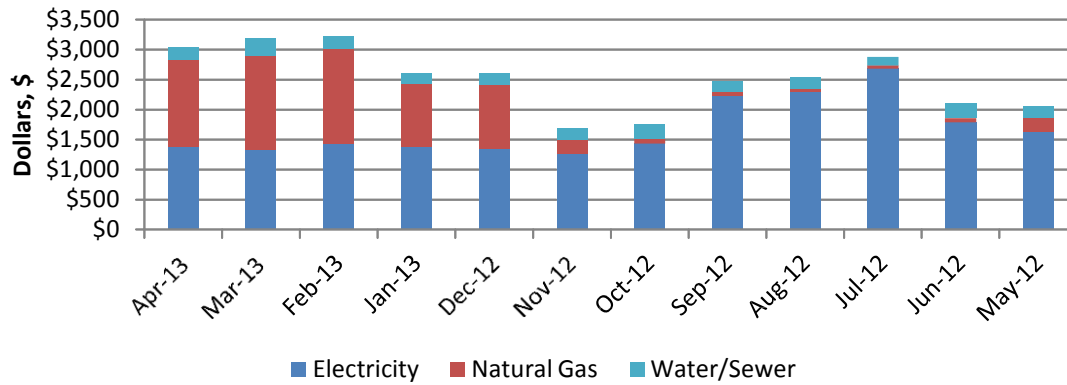
Data from a 2003 Department of Energy Survey indicates that congregations in the United States spend between \$0.25 and \$1.30 per square foot annually on energy. As of 2011, most of the churches expending less than \$1.00 per square foot have worked to control their energy costs through efforts such as installation of improved lighting and lighting controls, careful monitoring of peak electrical consumption, and improved HVAC controls. The United Church of Chapel Hill average energy consumption per square foot (Energy Index) of heated and cooled space is about 44.1 thousand BTU/sq. ft./year with an energy cost per square foot of \$0.74 which is approximately 25% below the average benchmark objective.

Summary of Energy Benchmarks	
Total Energy Consumed:	1,655 Million Btu / yr
Total Energy Index:	44 kBtu / sq ft / yr
Total Energy Cost:	27,688 \$ / yr
Total Energy Cost Index:	0.74 \$ / sq ft / yr

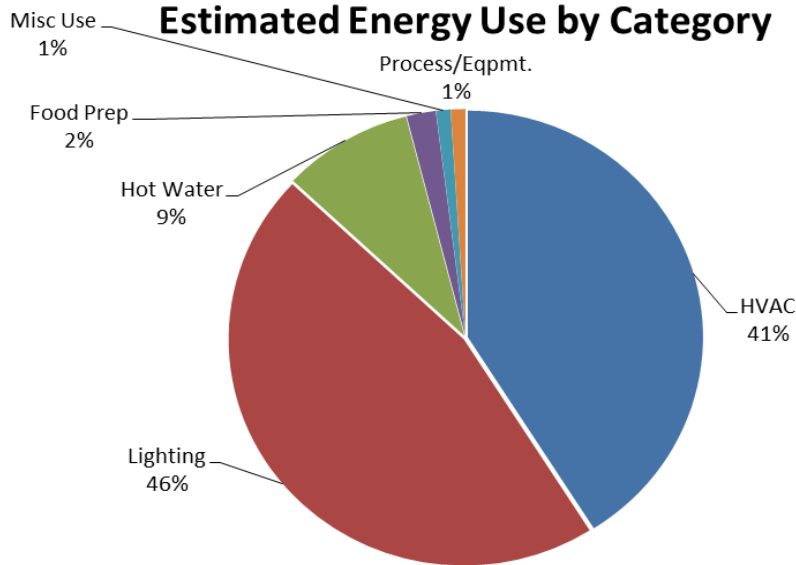
Monthly Energy and Utility Costs

United Church of Chapel Hill

May, 2012 to Apr, 2103



Estimated Energy Use by Category



Environmental Sustainability Factors

Resource Consumption	Annual Costs Apr-13 - May-12	Annual Consumption (Units)
Electricity	\$20,219	225,520 kWh
Natural Gas	\$7,469	8,853 Therms
<i>Energy Subtotal for Facilities</i>	<i>\$27,688</i>	<i>1,655 Million Btu's</i>
Water (cost includes sewer)	\$2,471	157,000 Gallons
Totals	\$30,159	
Pollution Sources	Annual Costs Apr-13 - May-12	Annual Quantity (Units)
Air Emissions (Pounds):		
Greehouse Gas (CO2e) - Carbon Footprint		358,172 Pounds
Nitrogen Oxides (NOx) - Ozone Precuser		369 Pounds
Sulfur Oxides (SOx) - Acid Rain Contributor		1,078 Pounds
Totals	\$0	

Summary of Findings and Recommendations

Estimated Annual Cost & Energy Savings			
Energy Cost Savings, \$ / Year	\$6,717	Electricity Savings, kWh/yr.	72,190
Water Cost Savings, \$ / Year	\$0	Natural Gas Savings, Therms/yr.	290
Total Cost Savings, \$ / Year	\$6,717	Fuel Oil Savings, Gallons/yr.	0
Energy Savings, MMBTU / Year	275	Propane Savings, Gallons/yr.	0
		Water Savings, Gallons / Year	0

Estimated Annual Emissions Reductions	
Carbon Equivalent, (CO ₂ e) - Greenhouse Gases, Pounds/Year	84,626
Nitrogen Oxides, (NO _x) - Precursor to Ozone, Pounds/year	93
Sulfur Oxides, (SO _x) - Contributes to Acid Rain, Pounds/Yr	345

The estimated CO₂ reductions amount to a reduction of 23.6% of the current amount

Summary of Recommendation Measures

Energy Efficiency Recommendations	Cost Savings / yr.	Investment Cost	Payback Period (yr)	mmBtu Saved
1)Replace Sanctuary CFL bulbs w/LED;2)Delamp stairways;3)Repl Narthex & sconces halogen w/LED	\$677	\$4,617	6.8	25.8
Delamp hallway overhead lighting fixtures	\$58			2.2
Adjust cooling temp up 2 degrees and heating temp down 1 degree	\$2,152		0.0	101.6
Install Variable Drives on air handler motors	\$3,747	\$3,500	0.9	142.6
Unplug Fellowship Hall TVs	\$5			0.2
Install occupancy sensors in lower level hallway	\$79	\$45	0.6	3.0
TOTAL for Energy and Water	\$6,717			275.3

Rebates are available from Duke Energy. The potential value is \$2,624 based on \$.35 per watt saved with LED lighting, \$06 per watt controlled with occupancy sensors and \$45/hp for VSD. Prior approval of Duke Energy is required.

Optional Measures and Future Choices

1. Continue annual HVAC maintenance performed by Piedmont Heating and Cooling.
2. Keep unoccupied room lights turned off- EPA estimates that Lighting is 15% to 30% of the electric bill.
3. Continue practice of shutting down PCs and PC equipment during non-working hours.
4. It was observed that most if not all exit signs are LED, please verify. If any incandescent ones are discovered, they should be replaced with LED exit signs which have a breakeven of less than a year. Duke energy provides rebates on conversion the LED exit signs.
5. Document current energy policies which could be utilized when a changeover of personnel occurs.
6. Form an energy conservation team. There is a de facto team now. The team needs to incorporate and encourage all of the users of the facilities to be aware of the need for energy conservation. The posting of signs reminding people to turn off light is a good start. Where members of the church may be well aware of this, many visitors that utilize the facility may not be as aware. People in general should be encouraged to report any conditions that appear to be a waste, abnormal or possible dangerous. The posting of signs asking for this help and identifying the method to report a problem, e.g. phone number, office location, etc., will assist the energy conservation team. In fact the action makes all of the users of the facility members of that team.

Background

The Waste Reduction Partners (WRP) program, administered by the Triangle J Council of Governments, provided technical assistance to the United Church of Chapel Hill beginning with a site visit on August 19, 2013. WRP assessors Ernie Swanson, Bruce Thoreson and Christal Perkins met with United Church of Chapel Hill representatives Tim Copland and Jon Haebig to discuss current energy uses at the Church. The representatives provided information regarding lighting, HVAC, and other energy consumers and provided a guided tour of the facility.

Facility Description

The 37,500 square building was built in two sections, the first section in 2000 and the addition in 2007. It is a two-level structure, the upper contains the sanctuary, offices, fellowship hall, meeting rooms and the main kitchen. The lower level is mainly preschool classrooms. The exit doors all appear to have good seals except for the one in the sanctuary. The windows and their seals appeared to be in good condition.

Hours of operation are 8 am till 8 pm, seven days per week for a total of approximately 80 hours per week. Facility staff workers and group participants occupy the facility with occupancy up to 450 depending on the activities taking place.

Utility Use Analysis

Electricity-Duke Energy provided electricity to the church for the 12 month period (May, 2012 to April, 2013) at a cost of \$20,219 for 225,520 kilowatt-hours or \$0.09 per kWh. The rate is LGS-Large General Service.

Natural Gas - PSNC provided natural gas for the same period at a cost of \$7,469 for 8,853 therms of natural gas at an estimated average rate of \$0.844 per therm.

Water and Sewer - Orange Water and Sewer Authority (OWASA) provided water and sewer services for the same period. The cost was \$2,471 for 157,000 gallons for water or \$0.16 per gallon. Water and sewer charges were approximately equal.

The total annual charges for utilities for 12 months (May, 2012 to Apr, 2013) were \$30,159 and total energy consumption for the period is estimated at 1,655 million BTUs.

Recommendations

CFL Lighting Details

1) There are (88) 42 watt CFL bulbs in the overhead hanging fixtures in the sanctuary. Assumed usage is 4 hours per day for organ playing and 7 hours on Sunday for two services. LED is a newer technology which offers advantages over the CFL bulbs. Some of these advantages are: 1) Extended life of up to 5 times (fewer light bulb changes)(40,000 hrs to 50,000 hrs versus CFL of 10,000 hrs); 2) Reduced air conditioning requirements by a factor of 10 per bulb; 3) no mercury in LED bulb as compared to 5mg mercury per CFL bulb; 4) 3yr commercial warranty with Xledia x125 A19 bulb. Proposed bulbs have 2000 lumens versus the current 2800 lumens). Potential savings 88 bulbs x reduced watts/bulb (42-16) x (4 hrs/day x 6 + 7 hrs = 31 hrs/wk x 52 wks/yr = 1612 hrs/yr) x \$0.09 x .001 = \$331 potential savings per year. plus intangible savings.

2) Delamp CFL fixtures by 33% in stairways with multi story glass windows. Lighting levels range from 65-82 fc in the back stairway and 52 to 72 fc in office entrance stairway. Guidelines are 10-20 fc. Total 18 bulbs x 33% x 42 watts/bulb x 9 hrs/day x 7 days/wk x 52 wks/yr x \$0.09 x .001 = \$74 potential savings per year.

Details of Recommendations -CFL Lighting

Current Lighting		Energy and Cost Savings						Investment Cost and Payback			
Loc't Key	Before Watts	After Watts	No. of Bulbs	Reduction per fixture Watts	Hrs. / Year	Energy Savings KWH / yr	Utility Cost Savings	Cost per Bulb	Labor Cost Bulb*	Total Investment Cost	Payback Years
Sanc	42	16	88	26	1612	3,688	\$331	\$44.99		\$3,959	12.0
Stairs	756	504	1	252	3276	826	\$74			\$0	
Narthx	50	3	40	47	1040	1,955	\$175	\$14.00		\$560	3.2
sconce	100	4	7	96	1612	1,083	\$97	\$14.00		\$98	1.0
Total						7,552	\$677			\$4,617	6.8

* Assumed replacement could be done within regularly scheduled staff time.

3) Replace (40) overhead 50w halogen bulbs with LED 3 watt bulbs. Assumption is that lights are on 20 hrs/wk x 52 wks/yr = 1,040 hrs/yr

4) Replace (7) wall sconce 100w halogen bulbs with LED 4 watt bulbs. Assume same usage as sanctuary. NOTE: A test should be done to validate adequate lighting is obtained.

Fluorescent Lighting Details

Delamp Hallways

1) Pastors offices hallway – Delamp overhead fixtures by 25%. Light level readings were 24 - 33 foot candles and recommended level is 10-20 fc. Recommendation is to remove 25% of the bulbs from (6) 2-2U bulb fixtures. Usage is based on 9 hrs per day, 7 days per week, 52 weeks per year. 12 bulbs x 25% x 28 watts/bulb x 9 hrs/day x 7 days/wk x 52 wks/yr x \$0.09/kWh x .001 (1/1000) = \$25 potential savings per year

2) Hallway to Chapel – Delamp fixtures by 25%. Light level readings were 28-33 fc and recommended level is 10-20 fc. Recommendation is to remove 25% of the bulbs from (8) 2 bulb fixtures. Usage is based on 9 hrs/day, 7 days/wk, 52 wks/yr. 16 bulbs x 25% x 28 watts/bulb x 9 hrs/day x 7 days/wk x 52 wks/yr x \$0.09/kWh x .001 (1/1000) = \$33 potential savings per year.

Details of Recommendations - Fluorescent Lighting

Loc't Key	Lamp Change		Ballast Change		Lumens per Fixture		Watts per Fixture			Calculation of Energy Savings		
	Before	After	Before	After	Before	After	Before	After	Reduction	No. of Units	Hrs. / Year	Saving KWH
1	2 2u 28 w	2 2u 28 w	na	na	na	na	336	252	84	1	3,276	275.18
2	2 X 4' 28w	2 X 4' 28w	na	na	na	na	448	336	112	1	3,276	366.91
	Total									2		642.10

Calculation of Cost and Payback - Fluorescent Lighting

Loc't Key	Change		Calculation of Utility Cost Savings			Calculation of Cost and Payback				
	Before	After	Cost per KWH	Savings KWH	Utility Cost Savings	No. of Units	Equip. Cost per Unit	Labor Cost per Unit	Total Investment Cost	Payback Years
1	2 2u 28 w	2 2u 28 w	\$0.09	275	\$25	1			\$0	
2	2 X 4' 28w	2 X 4' 28w	\$0.09	367	\$33	1			\$0	
	Total				\$58				\$0	

HVAC Details

Temperature is controlled by a central control panel for all areas in the church except the sanctuary. The operating temperature for cooling is set at an average of 74 degrees and heating is set at an average of 71 degrees. Recommendation is to set cooling temp up 2 degrees (23% savings) and heating temp down 1 degree (8% savings). It is noted that the temperature in the sanctuary is controlled by a separate programmable thermostat which is manually changed when the organists are practicing. The organ is very sensitive to temperature and humidity, so no recommendation is made. Additionally, variable speed drives should be installed on 7 HVAC air handler motors to improve efficiency. Fan motors range from .25 to 10hp. Calculation will be based on air handler motor hp x .746 kw/hp x (current ratio of .94 - VSD ratio of .32) x 4380 hrs/yr (50% of yearly hours) x \$0.09 \$/kWh = Yearly savings.

Current operating costs for 7 motors = \$5,507/yr

Operating costs of VSD = .32 (factor based on average speed of VSD motor) x \$5,507/yr = \$1,762/yr

Estimated savings = \$5,507 - \$1,762 = \$3,745/yr

Costs for 7 VSDs = (\$200ea + sensor @ \$100ea + installation costs=\$200ea) x 7 = \$3,500

Payback period = \$3,500 / \$3,745 = .9 years

Potential rebate from Duke Energy is currently \$45/hp. Contact Duke Energy to validate rebates prior to installation.

Details of Recommendations - HVAC

Items Due to HVAC Changes	Electricity			Natural Gas			Fuel Oil			Propane		
	% of Total	% Red'n	KWH Saved	% of Total	% Red'n	Therms Saved	Percent of Total	% Red'n	Gallons Saved	% of Total	% Red'n	Gallons Saved
Adjust temp set	41%	23%	21,267	41%	8%	290			0			0
Install VSD	41%	45%	41,793			0			0			0
Total energy savings by fuel			63,060			290			0			0

Solar film might be beneficial for stairway windows to reduce solar heat gain in the summer. According to one manufacturer of solar film, annual energy savings of up to 19 kWh/ft2 of installed film are possible, and paybacks are typically in 1 – 2 years. WRP recommends United Church evaluate the costs and benefits of solar film for this application. Consideration should also be given to the possibility of increased heat loads due to blocking entering heat during the winter months.

Occupancy Sensor and Fellowship Hall TVs

- 1) It was observed there are two TVs plugged in which are rarely if ever used. Recommendation is to unplug.
- 2) Install occupancy sensors in the lower level classroom hallway. There are two switches and the assumption is lights are on 25% of the time when hallway is unoccupied.

1. TVs in Fellowship Hall

Loc't Key	# of Units	Watts Red'n	% Op. Time	CF to KWH	Hrs/ Yr.	KWH Saved	Rate	Savings/ year	Labor Cost	Equip. Cost	Payback (Yrs.)
Hall	2	3	100%	0.001	8,760	53	\$0.09	\$5			
Subtotal						53		\$5	\$0.00	\$0.00	0.0

2. Install Occupancy sensor in classroom hallway

Loc't Key	# of Units	Watts Red'n	% Op. Time	CF to KWH	Hrs/ Yr.	KWH Saved	Rate	Savings/ year	Labor Cost	Equip. Cost	Payback (Yrs.)
Lower	1	504	100%	0.001	1,752	883	\$0.09	\$79	\$20.00	\$25.00	0.6
Subtotal						883		\$79	\$20.00	\$25.00	0.6
Grand Total						936		\$84	\$20.00	\$25.00	0.5

Appendices

A. Facility Statistics

Square Footage	Year Constructed	Hours Occupied per Week	# of Occupants
37,500	Orig: 2000; Addition: 2007	80	from 2 to 450

B. Utility History

Mo / Yr	Elect-All Usage KWH	Electric Cost	Nat Gas Usage Therms	Nat Gas Cost	Oil Usage Gallons	Oil Cost	Propane Usage Gallons	Propane Cost	Water Usage Gallons	Water / Sewage Cost
Apr-13	15,440	\$1,371	\$1,714	\$1,466	0	\$0	0	\$0	14,000	\$199
Mar-13	14,880	\$1,336	\$1,827	\$1,559	0	\$0	0	\$0	23,000	\$295
Feb-13	16,320	\$1,424	\$1,855	\$1,582	0	\$0	0	\$0	15,000	\$210
Jan-13	15,760	\$1,386	\$1,332	\$1,052	0	\$0	0	\$0	11,000	\$167
Dec-12	15,280	\$1,353	\$1,344	\$1,061	0	\$0	0	\$0	14,000	\$199
Nov-12	13,840	\$1,263	\$263	\$231	0	\$0	0	\$0	14,000	\$194
Oct-12	15,440	\$1,439	\$70	\$73	0	\$0	0	\$0	14,000	\$252
Sep-12	24,400	\$2,236	\$44	\$53	0	\$0	0	\$0	9,000	\$180
Aug-12	26,160	\$2,298	\$45	\$53	0	\$0	0	\$0	10,000	\$194
Jul-12	31,200	\$2,684	\$48	\$56	0	\$0	0	\$0	6,000	\$136
Jun-12	19,120	\$1,790	\$57	\$63	0	\$0	0	\$0	14,000	\$252
May-12	17,680	\$1,639	\$254	\$220	0	\$0	0	\$0	13,000	\$194
Total	225,520	\$20,219	8,853	\$7,469	0	\$0	0	\$0	157,000	\$2,471

	Utility Totals		Conversion to BTU Equivalents	Total Units
Electricity	225,520	X	3,413 Btu/kWh =	770 Million Btu's
Natural Gas	8,853	X	100,000 Btu/Therm =	885 Million Btu's
Total Energy Use	=	1655.000 MMBtu's		
Total Sq. Ft.	=	37500.000 FT ²		
Total Energy Index	=	44.133 kBtu's/sq ft		
TOTAL COST INDEX	=	0.738 \$ / SQ FT		

C. Resources and Fact Sheets

Financial Incentives for Energy Projects

[Duke Energy Business Incentive s](#) - Duke Energy's Super Saver Program offers incentives for many energy efficiency upgrades, including lighting upgrades. These incentives will reduce investment cost and shorten payback periods for the upgrades. For more information, please visit:

<http://www.duke-energy.com/north-carolina-business/smart-saver/smart-saver-incentive-program-customer.asp>

[Other Financial Incentives - Federal, state and local](#) - North Carolina businesses may take advantage of financial incentives and low interest loans for eligible renewable energy and efficiency projects. Financing incentives and loans include the following:

- Energy Efficient Commercial Building Tax Deduction (\$0.30 – \$1.80 square foot) - Federal
- 35% NC Renewable Energy Tax Credit
- 30% Federal Business Energy Tax Credit---solar, fuel cell, small wind
- 10% Federal Business Tax Credit--- geothermal, microturbines, and CHP
- USDA Rural Energy for America Program (REAP) – Grants for up to 25% of the cost of eligible renewable and efficiency projects for rural small businesses and agriculture:

The incentives above are only a partial list of what is available in NC. Many of the state's utilities have incentive programs for energy projects. For a complete list of local, state and federal incentives and rebates, go to the Database of State Incentives for Renewables & Efficiency (DSIRE) website: <http://www.dsireusa.org/>.

Environmental Stewardship Initiative

DENR's Environmental Stewardship Initiative is designed to promote and encourage superior environmental performance by North Carolina's regulated community. This voluntary program provides benefits and technical assistance to stimulate the development and implementation of programs that use pollution prevention and innovative approaches to meet and go beyond regulatory requirements. This program seeks to reduce the impact on the environment beyond measures required by any permit or rule, producing a better environment, conserving natural resources and resulting in long-term economic benefits. Members say the top benefits include networking and exchanging ideas with other organizations, and the technical assistance that DENR provides.

For more information on the Environmental Stewardship Initiative, please visit www.ncesi.org

Waste Reduction Partners Technical Publications

Waste Reduction Partners has created a number of technical publications to help you pursue your utility cost-saving and environmental goals. Click on the link below to open the document.

[Self-Assessment Guide for Energy Saving Opportunities](#)

[Benchmarks - Ranking Building Energy Intensity](#)

[Caulk and Weather Stripping](#)

[CFL Retrofits in Commercial Lighting](#)

[Chillers](#)

[Drinking Fountains and Water Coolers](#)

[Exhaust Fans](#)

[Exit Signs](#)

[Fluorescent Light and Ballast Recycling](#)

[High Bay Lighting](#)

[Insulation Guidelines](#)

[Monitor Power System](#)

[Occupancy Sensors](#)

[Setback Temperature Control](#)

[T-12 to T-8 Conversion](#)

[Task Lighting](#)

[Tracking Energy Savings](#)

[Vending Machines](#)

[Ventilation and Indoor Air Quality](#)

[Commercial Kitchens](#)

[Commercial Washing Machines](#)

[Commercial Dishwashers](#)

[WRP Fact Sheet Compilation \(includes all fact sheets listed above\)](#)

D. Follow-up Evaluation

Waste Reduction Partners provides energy, solid waste, water, and pollution prevention assessments to institutional and business entities throughout North Carolina. These assessments are confidential, non-regulatory, and provided at no or reduced cost to the client. A follow-up contact will be made with clients 6-12 months after this assessment report has been delivered to discuss the value of the assessment. The purpose of the follow-up is to evaluate the effectiveness of our reports and consultation and to determine if report recommendations were found to be worthy of implementation. You are encouraged to take the few minutes required to complete the follow-up in order to help Waste Reduction Partners continually improve its services.